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NEW CLAIMS

1. A diaphragm valve (5), which comprises a valve body (1), consisting of an inlet sleeve (3) and an outlet sleeve (4), which have a curved shape and equal circular sections, and converge one into the other until they open into a fluid flow chamber, which contains the valve seat (106), substantially consisting of the flattened and slightly concave surface of the line (6) of intersection of the two sleeves (3, 4) on the opposed sides thereof, which chamber is divided into two parts with respect to a plane parallel to the plane tangent to the lower apex of the surface of the valve seat (106), one part whereof is integrated in the valve body (1), and is peripherally delimited by a clamping flange (101), and the other part consists of a bonnet (2) to be sealably secured onto said valve body (1), which bonnet has a coincident peripheral clamping flange (102), an open/close element consisting of an elastic diaphragm (5) being provided, made of rubber or the like, which has a peripheral sealing flange (105) to be clamped between the peripheral flanges (101, 102) of said two parts of the chamber, said flange (105) being connected to a central dome-shaped convex part (305) whose convexity is oriented, in an unstressed position, toward the valve seat (106), and means being provided, on the concave side of the diaphragm (5), facing toward the bonnet, to compress the diaphragm against the surface of the valve seat (106) in such a manner that, when the diaphragm (5) is compressed

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against said surface (106), any fluid flow from the inlet sleeve (3) to the outlet sleeve (4) is prevented whereas, when the diaphragm (5) is lifted and deformed toward the bonnet (2), free fluid flow is allowed, characterized in that the cross sections of the inlet sleeve (3) and the outlet sleeve (4), at the ends opening into the flow chamber, and at the valve seat (106), are flattened in the direction of flow, i.e. along the axis that joins the centers of the two inlet and outlet ends of the sleeves, opening into the flow chamber, and are elongated in a direction transverse to the direction of flow, particularly having a substantially elliptic shape, or anyway inscribable in a substantially rectangular peripheral clamping flange (101), and with the longer side disposed in a direction transverse to the direction of flow, <sup>CHARACTERIZED IN THAT</sup> the peripheral flange (105) of the diaphragm (5) <sup>HAS</sup> having a corresponding rectangular shape, inscribing the central convex portion (305) of the diaphragm (5), which consists of an element having the shape of a sector of an ellipsoid or similar, whose section plane is disposed in such a manner as to correspond with the flow chamber port.

2. A valve as claimed in claim 1, characterized in that, from the respective free ends to the ends that open into the flow chamber, the sleeves (3, 4) have a cross section that progressively widens in a direction transverse and perpendicular to the flow direction and parallel to the separation plane between the two chamber parts (1, 2), and progressively narrows in a

direction substantially coincident with the bending radius of each sleeve (3, 4) so that the flow chamber port, at the flange (101) of the chamber part integrated in the valve body (1), has a shape that is  
5 flattened in the flow direction and elongated in a direction transverse to said flow direction, and particularly has a substantially elliptic shape, or anyway inscribable in a peripheral, substantially rectangular clamping flange (101), with the longer side  
10 disposed transverse to the flow direction, the peripheral flange (105) of the diaphragm (5) having a corresponding rectangular shape, inscribing the central convex portion (305) of the diaphragm (5), which consists of an element having the shape of a sector of  
15 an ellipsoid or similar, whose section plane is disposed in such a manner as to correspond with the flow chamber port.

3. A valve as claimed in claim 1 or 2, characterized in that the dome (305) of the diaphragm  
20 (5) has one or more stiffening ribs (405, 505), to enhance the resiliency of the dome (305) from the condition in which it is deformed toward the bonnet (2) to the normal unstressed condition, with the convexity being oriented toward the valve seat (106), in such a  
25 manner as to prevent the dome (305) from bowing out when the latter is compressed against the valve seat (106).

4. A valve as claimed in one or more of the preceding claims, characterized in that at least one  
30 rib (405) is provided on the concave side of the dome

(305) of the diaphragm (5), facing toward the bonnet (2), which rib is oriented along the central longer axis of said dome (305), or at least two crossed ribs (405, 505) may be provided therein, oriented along the longer axis and the shorter axis of the section plane of the sector of ellipsoid that forms the dome (305).

5 5. A valve as claimed in one or more of the preceding claims, characterized in that a plurality of ribs (505) are provided on the concave side of the dome (305) of the membrane (5), facing toward the bonnet (2), which ribs are oriented transverse, preferably perpendicular to the longer axis of the dome (305) and/or are oriented along the shorter axis of the dome (305), which may be equally spaced or distributed  
10 unevenly along said longer axis and/or may be symmetrical with respect to it or have non coincident positions on the two sides of said longer axis.

6. A valve as claimed in one or more of the preceding claims 1 to 4, characterized in that at least  
20 one or more additional pairs of ribs (505) are provided on the concave side of the dome (305) of the diaphragm (5), facing toward the bonnet (2), which ribs are disposed in such a manner as to divide the four quadrants formed by the rib (405) along the longer axis and the transverse rib (505) along the shorter axis,  
25 into two or more webs, while connecting the center of the dome (305) with the arched periphery of the dome (305).

7. A valve as claimed in one or more of the preceding claims, characterized in that a central  
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stiffening member (605), particularly having a circular shape, is provided on the concave side of the dome (305) of the diaphragm (5) that faces toward the bonnet (2).

5           8. A valve as claimed in one or more of the preceding claims, characterized in that the ribs (405, 505) and/or the central stiffening member (605) consist of local thickened wall portions of the dome (305) of the diaphragm (5).

10           9. A valve as claimed in one or more of the preceding claims, characterized in that the dome (305) of the diaphragm (5) has a constant thickness, whereas at least some of the stiffening ribs (405, 505) have a thickness that progressively increases toward the  
15 center of the dome (305).

          10. A valve as claimed in one or more of the preceding claims, characterized in that means (705, 402) are provided for holding the periphery of the flange (105) of the diaphragm (5) in such a manner as  
20 to prevent it from sliding along the plane of the clamping flanges (101, 102) of the bonnet (2) and the valve body (1), and from being pulled out from between said coupled clamping flanges (101, 102).

          11. A valve as claimed in one or more of the  
25 preceding claims, characterized in that said retaining means consist of one or more retaining teeth arranged along the peripheral edge of the flange (105) of the diaphragm (5), which extend over the surface of the outer edge of the flanges (101, 102) of the valve body  
30 and/or the bonnet with a vertical orientation with

respect to the plane of the flanges (101, 102).

12. A valve as claimed in one or more of the preceding claims, characterized in that said retaining means consist of two retaining tabs (705), each being  
5 provided along one of the longer sides of the flange (105) of the diaphragm (5), particularly in the intermediate area between two through holes (205) into which pins are inserted to hold the flange (102) of the bonnet (2) against the flange of the valve body (1),  
10 each of which holes (205) is provided in one of the four corners of the flange (105) of the diaphragm (5), which tabs extend over the corresponding surface of the outer edge of the flange (101) of the valve body (1) with a vertical orientation with respect to the plane  
15 of said flange (101).

13. A valve as claimed in one or more of the preceding claims, characterized in that said retaining means consist of one or more bosses (402) provided on the clamping surface of the flanges (101, 102) of the  
20 bonnet (2) and/or the valve body (1) which, with said two flanges (101, 102) in the coupled condition, compress the corresponding portion of the flange (105) of the diaphragm (5) thereby further preventing it from being slid out.

25 14. A valve as claimed in one or more of the preceding claims, characterized in that said retaining means consist of a substantially elliptic continuous or discontinuous projection (402), provided on the clamping surface of the flange (102) of the bonnet (2)  
30 which, with said flange being pressed against the

flange (101) of the valve body (1), extends along the substantially elliptic peripheral edge of the dome (305) of the diaphragm (5) and at a certain distance therefrom.

5           15. A valve as claimed in one or more of the preceding claims, characterized in that means (502) are provided for centering the bonnet (2) with respect to the valve body (1) and for laterally limiting any outward extension of the flange (105) of the diaphragm  
10 (5).

          16. A valve as claimed in one or more of the preceding claims, characterized in that said means consist of one or more retaining teeth arranged along the outer peripheral edge of the flange (102) of the  
15 bonnet part (2), which extend over the surface of the outer edge of the flange (101) of the valve body (1) with a vertical orientation with respect to the plane of the flanges (101, 102).

          17. A valve as claimed in one or more of the preceding claims, characterized in that said means consist of a tab (502) that continuously extends along the whole peripheral edge of the flange (102) of the bonnet (2), which tab (502) extends over the  
20 corresponding surface of the outer edge of the flange (101) of the valve body (1), with a vertical orientation with respect to the plane of said flange (101).  
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          18. A valve as claimed in one or more of the preceding claims, characterized in that the flange  
30 (105) of the diaphragm (5) has at least one lip seal

(805, 805'), particularly having a substantially elliptic shape, on at least one face, preferably on both faces, which seal extends along the peripheral edge of the dome (305) of the diaphragm (5) and at a  
5 certain distance therefrom.

19. A valve as claimed in one or more of the preceding claims, characterized in that a central, rounded lip seal (905) is provided on the convex side of the dome (305) of the diaphragm (5) facing toward  
10 the valve seat (106), which seal extends along the longer axis of the section plane of the sector of ellipsoid that forms the dome (305) and which, with the dome (305) compressed against said valve seat (106), acts as a compliant element and helps the dome (305) to  
15 adhere against said seat (106) to prevent any fluid flow from the inlet sleeve (3) to the outlet sleeve (4).

20. A valve as claimed in one or more of the preceding claims, characterized in that a rib is  
20 provided in an intermediate position of at least the port of the outlet sleeve (4) opening into the flow chamber, which rib is oriented in the flow direction and is substantially perpendicular to the plane tangent to the lower apex of the surface of the valve seat  
25 (106), which has, at its edge facing toward the dome (305) of the diaphragm (5), a flattened and correspondingly curved surface, in such a manner as to prevent the dome (305) from bowing out when the latter is compressed against the valve seat (106).

30 21. A valve as claimed in one or more of the

preceding claims, characterized in that it is a manually operated or servo valve.

22. A valve as claimed in one or more of the preceding claims, characterized in that it is a mechanically operated valve, a compressor element (8) being provided on the side of the dome (305) of the diaphragm (5) facing toward the bonnet, which element has a pressing surface whose shape is complementary to the dome (305), and is rotatably linked to the inner end of a slidable control stem which is passed through a hole formed in the bonnet part (2).

23. A valve as claimed in one or more of the preceding claims, characterized in that it is a hydraulically operated valve, means (203, 302) being provided for supplying a pressurized fluid, preferably the same fluid as supplied to the inlet sleeve (3) of the valve, between the bonnet part (2) and the dome (305) of the diaphragm (5), for the purpose of compressing the dome (305) against the valve seat (106) to close the valve, and means for discharging said pressurized fluid to open the valve.

24. A valve as claimed in one or more of the preceding claims, characterized in that means (7) are provided for elastically preloading the dome (305) of the diaphragm (5), whose convexity is oriented toward the valve seat (106).

25. A valve as claimed in one or more of the preceding claims, characterized in that said means consist of a spring (7) which is interposed in the central position of the opposed surfaces of the bonnet

(2) and the dome (305) of the diaphragm (5), while a rigid pressure element (8), whose shape corresponds to the concave surface of the dome (305), may be interposed between said spring (7) and said dome (305).

5           26. A valve as claimed in one or more of the preceding claims, characterized in that the body (1) is made of plastic, the flow chamber being composed of two pocket-like chambers closed at their bottoms, and open at their upper sides, which pocket-like chambers (13,  
10   14) are disposed in adjacent positions, with their upper openings being connected to a common opening (206) of the flow chamber, that has a flattened shape in the flow direction, particularly an oval shape, and especially an elliptic shape, which edge of the opening  
15   (206) is surrounded by a clamping flange (101) that is inscribable in a rectangle, whereas the two pocket-like chambers (13, 14) have two opposed walls (113, 114), whose upper edge, facing toward the opening (206) is concave and arched in such a manner as to slope down  
20   toward the central area from the two opposite ends substantially provided level with the peripheral flange (101) and/or with the edge of the opening (206), whereas said upper edges of the two opposed walls (113, 114) of the two pocket-like chambers (13, 14) are  
25   connected to each other by a surface that forms the valve seat (106).

          27. A valve as claimed in claim 26, characterized in that the inlet and outlet sleeves (3, 4) are connected substantially perpendicular to the sides of  
30   the pocket-like chambers (13, 14) , which sides are

perpendicular or transverse to the flow direction, the axes of said sleeves (3, 4) being oriented substantially perpendicular to the axes of the upper openings of the pocket-like chambers (13, 14) and/or of the common opening (206).

28. A valve as claimed in claim 26 or 27, characterized in that the two opposed walls (113, 114) of the two pocket-like chambers (13, 14) are divergent and/or possibly spaced and divergent and are connected together by a plurality of stiffening ribs that are oriented perpendicular to the flange (101) and parallel to the flow direction.

29. A valve as claimed in claim 28, characterized in that at least some of the stiffening ribs for connecting the two pocket-like chambers (13, 14) extend all over the length of the outer edge of the two opposed walls (113, 114) of said pocket-like chambers (13, 14) from the outer end that forms the valve seat (106) to a position substantially flush with the bottom side of the pocket-like chambers (13, 14).

30. A valve as claimed in claim 28, characterized in that at least some of the stiffening ribs for connecting the two pocket-like chambers (13, 14) extend all over the height of the outer edge of the two opposed walls (113, 114) of said pocket-like chambers (13, 14) from the outer end that forms the valve seat (106) to a position beyond the bottom side of the pocket-like chambers (13, 14), thereby forming supporting spacers or feet.

31. A valve as claimed in one or more of the

preceding claims, characterized in that the bonnet (2) is made of plastic or sheet metal, the latter being shaped by a drawing or molding process.

32. A valve as claimed in one or more of the preceding claims, characterized in that the flange (105) of the diaphragm (5) is clamped between the flange (101) of the valve body (1) and the flange (102) of the bonnet (2) by using more than four fastening bolts at the corners of the shorter sides of said flanges, i.e. of the sides thereof that are oriented in the flow direction.

33. A diaphragm valve, wholly or partly substantially as described, illustrated and for the purposes stated herein.

34. A diaphragm open/close element for a valve as claimed in one or more of the preceding claims, characterized in that it has a peripheral flange (105) that has a corresponding rectangular shape, which inscribes the central convex portion (305) of the diaphragm (5), consisting of an element shaped like a sector of an ellipsoid or similar, which is joined to said flange (105), disposed in the section plane of said ellipsoid or the like.

35. A diaphragm open/close element as claimed in claim 34, characterized in that the dome (305) of the diaphragm (5) has one or more stiffening ribs (405, 505), to enhance the resiliency of the dome (305) from the deformed condition to the normal unstressed condition, in such a manner as to prevent the dome (305) from bowing out when the latter is stressed to

the closed condition.

36. A diaphragm open/close element as claimed in claim 34 or 35, characterized in that at least one rib (405) is provided on the concave side of the dome (305) of the diaphragm (5), which rib is oriented along the central longer axis of said dome (305), or at least two crossed ribs (405, 505) may be provided therein, oriented along the longer axis and the shorter axis of the section plane of the sector of ellipsoid that forms the dome (305).

37. An open/close element as claimed in claim 36, characterized in that a plurality of ribs (505) are provided on the concave side of the dome (305) of the membrane (5), which ribs are oriented transverse, preferably perpendicular to the longer axis of the dome (305) and/or are oriented along the shorter axis of the dome (305), which may be equally spaced or distributed unevenly along said longer axis and/or may be symmetrical with respect to it or have non coincident positions on the two sides of said longer axis.

38. An open/close element as claimed in one or more of the preceding claims 34 to 37, characterized in that at least one or more additional pairs of ribs (505) are provided on the concave side of the dome (305) of the diaphragm (5), which ribs are disposed in such a manner as to divide the four quadrants formed by the rib (405) along the longer axis and the transverse rib (505) along the shorter axis, into two or more webs, while connecting the center of the dome (305) with the arched periphery of the dome (305).

39. An open/close element as claimed in one or more of the preceding claims 34 to 38, characterized in that a central stiffening member (605), particularly having a circular shape, is provided on the concave  
5 side of the dome (305) of the diaphragm (5).

40. An open/close element as claimed in one or more of the preceding claims 34 to 39, characterized in that the ribs (405, 505) and/or the central stiffening member (605) consist of local thickened wall portions  
10 of the dome (305) of the diaphragm (5), whereas the dome (305) of the diaphragm (5) has a constant thickness and at least some of the stiffening ribs (405, 505) have a thickness that progressively increases toward the center of the dome (305).

15 41. A valve as claimed in one or more of the preceding claims, characterized in that the body of a meter or another device is integrated with the valve body.